

REMARKS

This response is being made pursuant to the Office Action mailed Oct. 19, 2004. Claims 1-13, 21 and 22 have been cancelled without prejudice by the present response. Claims 17, 19, 20, 23-26, and 28-39 remain pending in the application.

PERSONAL INTERVIEW WITH THE EXAMINER

The undersigned initially wishes to express his appreciation to the examiner for the courtesy of the personal interviews on June 24, 2004 and Dec. 15, 2004.

OBJECTION TO THE DRAWINGS

New drawing figures for Figures 1 and 5 have been submitted, together with new drawing Figures 5a-5c and 6a-6c (and accompanying text in the specification). No new matter has been added to the application. Amended Figure 1 (Prior Art) is different from originally filed Figure 1, in that has been slightly amended so that the number of slots in the rotor ("R" in the Figure) matches the number of slots in the armature shown in Figure 5. The brushes have been drawn in a vertical orientation to more easily show the windings. The windings of the two coils labeled X and Y are shown coupled to the commutator bars in the conventional fashion.

Amended Figure 5 differs from originally submitted Figure 5 in that the commutator brushes are drawn vertically opposed rather than horizontally opposed, as this allows the winding connections to the commutator bars to be illustrated without the misleading appearance that one or more of the windings are physically coupled to the brush (in which case the motor obviously would not work). The commutator bars and

connections of a pair of coils have also been shown and conform to the diagram of Figure 4 for the first and second coils. Accordingly, Figure 5 merely forms a highly simplified physical representation of the structure shown in the top one-half of Figure 4.

New Figures 5a-5c and 6a-6c illustrate an example of the angular positioning of the resultant magnetic axis of the coils wound on the armature of the present invention, relative to the position of the field pole, the position of the commutator bars to which the coils are coupled, and a brush to which the coils are coupled. These figures only serve to further illustrate what is described in the specification with regard to the angular positioning of the magnetic axis of each coil that results in coincident, overlapping commutation zones, and which is shown in Figure 5.

ELECTION/RESTRICTION

By the present action, previously withdrawn claims 1-13, 21 and 22 have been cancelled.

CLAIM REJECTIONS UNDER 35 U.S.C. § 112

Claims 23-25 were rejected under 35 U.S.C. §112, first paragraph, as not providing a sufficiently detailed description of the invention as it relates to the shifting of the magnetic axes of the two coils wound in each armature slot. It is believed that the newly added drawing Figures 5a-5c and 6a-6c, as well as the added text in the specification relating to these new Figures, address this concern. Figures 5a-5c and 6a-6c merely further illustrate what is produced by the winding pattern illustrated in Figure 4 for the first and second coils, and further illustrate the coincident commutation regions that are described and shown in connection with originally filed Figure 5.

Again, no new matter has been added by the submission of these drawing figures and the accompanying text in the specification of the present application.

CLAIM REJECTIONS UNDER 35 U.S.C. § 103

Claims 17, 23, 26, 28, 29, 30, 31, 34, 36 and 38 were rejected under 35 U.S.C. 103(a) as being unpatentable over Klein (US 4,329,610; hereinafter "Klein") and Van Assema (US 5,172,870). The Examiner cited Klein as allegedly teaching a machine having armature coils with series wound subcoils, where the coils are commutated while passing the neutral zone (the center of the pole), and where all of the coils are commutated at the center of the pole, and that one subcoil is advanced of the field pole and one is retarded (relative to the field). The undersigned respectfully traverses this determination. To illustrate the differences between Klein and the subject matter of the present application, Exhibits A and B have been prepared. Exhibit A was discussed at the Dec. 15, 2004 interview with the Examiner. Exhibit B is new and has been made per the Examiner's suggestion when Klein was being discussed at the Dec. 15th interview. These two Exhibits are being submitted to help the Examiner understand how Klein differs from the embodiments described in the present application.

Exhibit A (Klein)

As discussed at the Dec. 15th interview, the figures in Exhibit A show the Klein winding pattern. The "stars" represent the magnetic axis of each subcoil of coils 1 and 2. The circle with cross hairs in it represents the "resultant" magnetic axis of the overall coil. The winding diagrams of Exhibit A and B were produced in accordance with the table of "Example 1" set forth in Klein in column 8, lines 55-68 and column 9, lines 1-17.

Each of Klein's coils is divided into two "halves" or subcoils. Klein numbered these first four coils as A, A', B, and B' instead of numerically as 1, 2, 3, and 4. Klein's subcoils are labeled in the Klein patent as a1, a2, a1', b2', etc. However, to even further aid in explaining Klein, the simple designations "Coil 1", "Coil 2", "Coil 3" and "Coil 4" have been included.

As discussed at the Dec. 15th interview, Coil 1 (A) has two subcoils wound in series and connected to commutator bars 1 and 2. Subcoil 1 (a1) is wound in slots 1 and 6, while subcoil 2 (a2) is wound in slots 1 and 8. The magnetic axis of each subcoil is denoted with "star". The numbers under the star show the slots in which the subcoil is wound. The resultant magnetic axis of the entire coil is denoted with a circled cross hairs as mentioned above. The first subcoil a1, wound in slots 1-6, can be seen to have a magnetic axis centered over the armature tooth between slots 3 and 4, while the second subcoil a2, wound in slots 1-8, can be seen to have a magnetic axis centered over the tooth between slots 4 and 5. The resultant magnetic axis of coil 1 (A) lies over slot 4, which is 1.5 commutator bars behind the gap between commutator bars 1 and 2 (i.e., retarded 22.5 degrees).

Coil 2 (A') has two subcoils wound in series and connected to commutator bars 2 and 3. The first subcoil of coil 2 (A') is wound in slots 1 and 6, while the second subcoil is wound in slots 1 and 8. The magnetic axis of each subcoil is again designated with a "star". The resultant magnetic axis of the two subcoils of coil 2 (A') falls over slot 4. This angular position is retarded by only one-half the width of a commutator bar (about 7.5 degrees) from the gap between bars 2 and 3.

The first subcoil of coil 3 (B) is wound in slots 2 and 7. The second subcoil resides in slots 2 and 9. Coil 3 is connected to bars 3 and 4. The resultant magnetic axis of coil 3 lies over slot 5. This resultant magnetic axis is retarded by 22.5 degrees from the gap between bars 3 and 4.

The first subcoil of coil 4 (B') is wound in slots 2 and 7. The second subcoil resides in slots 2 and 9. Coil 4 is connected to bars 4 and 5. The resultant magnetic axis of coil 4 is over slot 5. This axis is retarded by 7.5 degrees from the gap between bars 4 and 5.

Thus, as explained at the Dec. 15th interview, the Klein winding pattern shows the same type of unevenness as seen in a standard 2 coil-per-slot winding pattern. The magnetic axes of successive coils alternately shift between 22.5 and 7.5 degrees of retardation with respect to the gap between their associated commutator bars. Thus, the resultant magnetic axis of each coil does NOT stay at the same angular position, relative to the pair of commutator bars to which each coil is attached. The resultant magnetic axis of successive coils instead alternates between shifting either 7.5 degrees from the brush gap or 22.5 degrees from the brush gap. As compared to newly added Figures 5a,6a and 5b,6b with the present invention, it can be seen that the resultant magnetic axis of each successive coil in the embodiment described in the present application **stays at a constant angular position relative to the two commutator bars to which each coil is attached.** In Figures 5a,6a and 5b,6b, the resultant magnetic axis of each coil stays at the gap between its associated commutator bars. However, the motor designer could change the angular relationship between the commutator bars and the coils so that the resultant magnetic axis of each coil falls at a

different (but consistent) angular position, but the important point is that the resultant magnetic axis ***stays at the same angular position relative to its associated commutator bars***. In this manner, commutation of each coil will begin at the same angular position, relative to the field pole, when its associated commutator bars are shorted as they pass across the fixed brush. Similarly, commutation of each coil will end at the same angular position, relative to the field pole, when the coil's associated commutator bars move past the fixed brush. The result is that coincident (i.e., fully overlapping) commutation regions are produced for all of the coils.

Exhibit B (Klein commutation):

Exhibit B includes the diagrams that the Examiner suggested (at the Dec. 15th interview) be prepared to illustrate where Klein's resultant magnetic axis is at the start and end of commutation of two successive coils. A brush and a field is superimposed on them. The resultant magnetic axis is again indicated by circled cross hairs as well as with a vertical dot/dashed line. The brush and field axis is also labeled.

Exhibit B illustrates 5 figures:

Figure 1 shows the position of coil 1 (A) as it just begins to commutate when the gap between bars 1 and 2 begins to be covered by the brush. The position of the magnetic axis of coil 1 at this time is again represented by a dot/dashed line.

Figure 2 shows the position of coil 1 as it completes commutation when the gap between bars 1 and 2 leaves the coverage of the brush. The position of the magnetic axis of coil 1 at this time is represented by a vertical dashed line. The angular distance

between the two parallel lines is the commutation region of coil 1. This region is in a fixed angular relationship with respect to the field and brush.

Figure 3 shows the position of coil 2 (A') as it just begins to commute. The position of the magnetic axis of coil 2 at this time is again shown by a dot/dashed line.

Figure 4 shows the position of coil 2 (A') as it completes commutation. The position of the magnetic axis of coil 2 at this time is again represented by a dashed line extending through the circled cross hairs. The angular distance between the two vertical lines is the commutation region of coil 2.

Figure 5 shows the angular, spatial relationship between the commutation regions of coils 1 and 2. As explained at the Dec. 15th interview, the two commutation regions are NOT coincident. The two regions overlap to some degree, but they do not start and end at the same angular position relative to the gap separating the two brushes to which each coil is attached. It is this “misalignment” or “non-coincidence” of the two commutating regions of successive coil pairs that results in the undesirable brush arcing.

With the embodiments described in the present application, and as was explained at the Dec. 15 interview with regard to new Figures 5a-5c and 6a-6c, the resultant magnetic axis of each coil is maintained at the *same angular position* relative to the commutator bars to which the coil is attached. This allows commutation for each coil to begin and end at same angular positions (relative to the field pole, and relative to the commutator bars to which each coil is attached) for each coil wound onto the armature. This differs significantly from Klein, which as described above results in an alternately “shifting” magnetic axis for successive coils. This alternating shifting of the

magnetic axis (relative to the commutator bars to which each coil is attached) results in the non-coincident commutation zones.

In view of the significant difference between Klein and the subject matter of the present application, as described above, it is believed that no comments concerning Van Assema are necessary. Reconsideration of this rejection is thus respectfully requested.

Claims 19-20, 24, 25, 32, 33, 35, 37 and 39 were also rejected under 35 U.S.C. 103(a) as being unpatentable over Klein and Van Assema, and further view of Latour (U.S. Patent No. 841,545). Again, in view of the above explanation of Klein, it is believed that this rejection has been rendered moot. Withdrawal and reconsideration of this rejection is requested.

DOUBLE PATENTING

The undersigned gratefully acknowledges the withdrawal of the double patenting rejection presented in the Office Action of March 2, 2004.


CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the

Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: January 12, 2005

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AMENDMENTS TO THE DRAWINGS

The attached "Replacement Sheets" of drawings include changes to Figures 1-6c. The attached "Replacement Sheets," which include Figures 1-6c, replaces the original sheets including Figures 1-5.

Attachment: Replacement Sheets

BEST AVAILABLE COPY

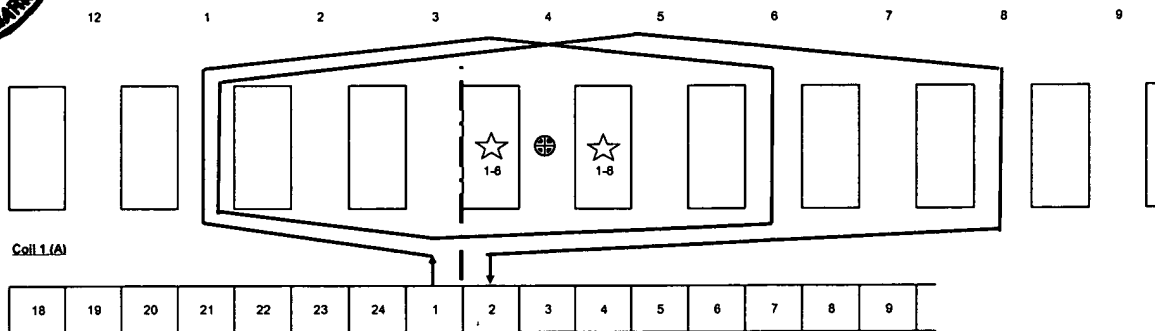


- Klein winding pattern

Number =====>

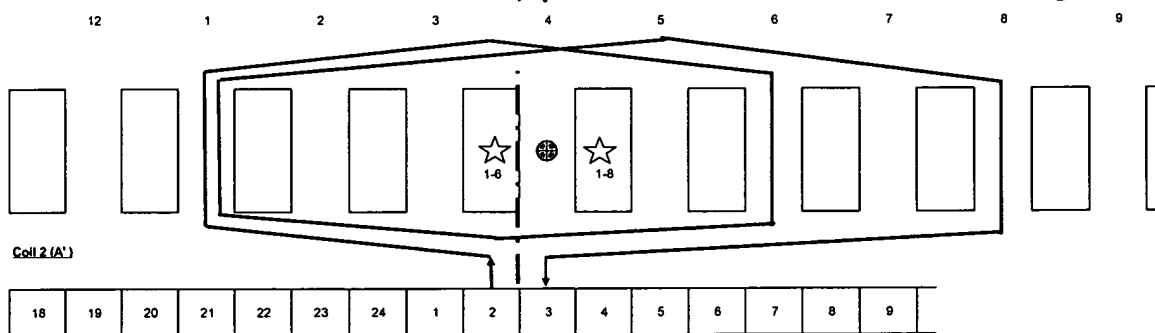
22.5°

COIL 1



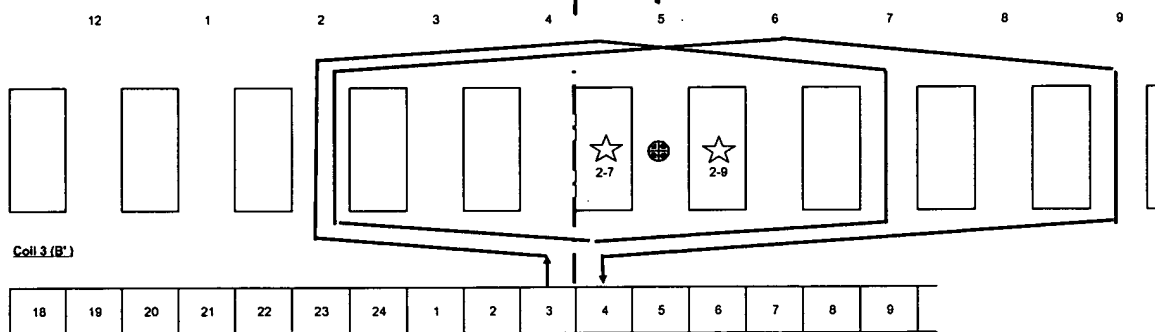
7.5°

COIL 2



22.5°

COIL 3



7.5°

COIL 4

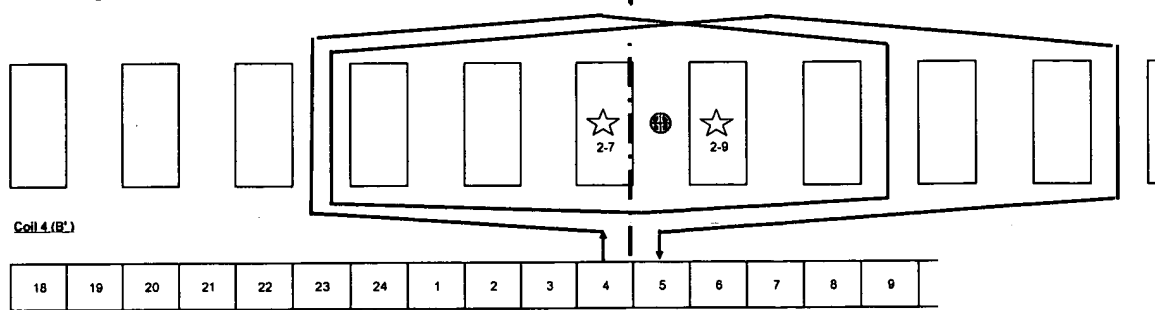


EXHIBIT A

- Klein commutation

FIGURE 1

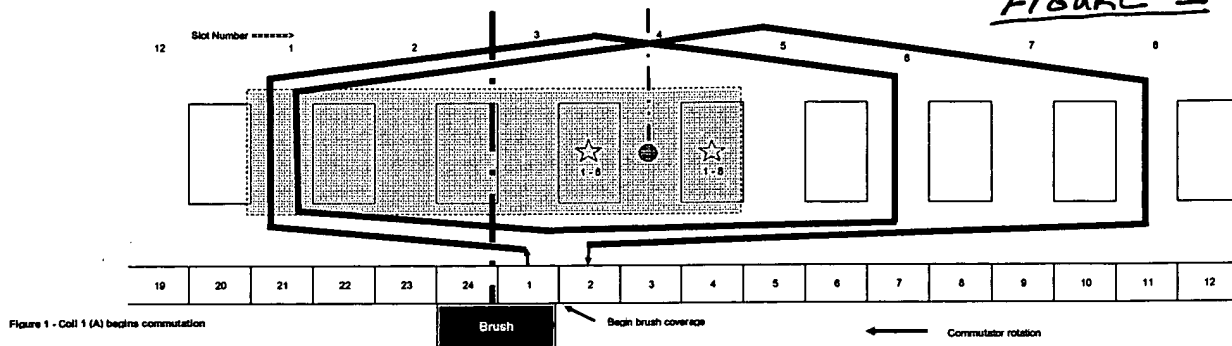


FIGURE 2

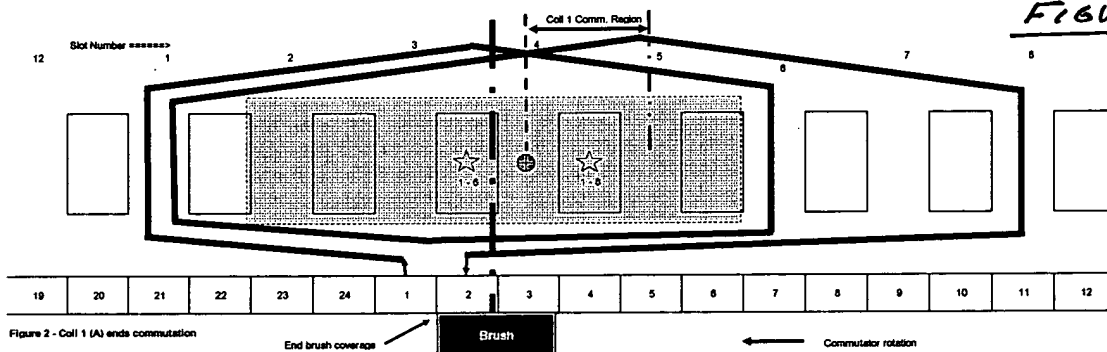


FIGURE 3

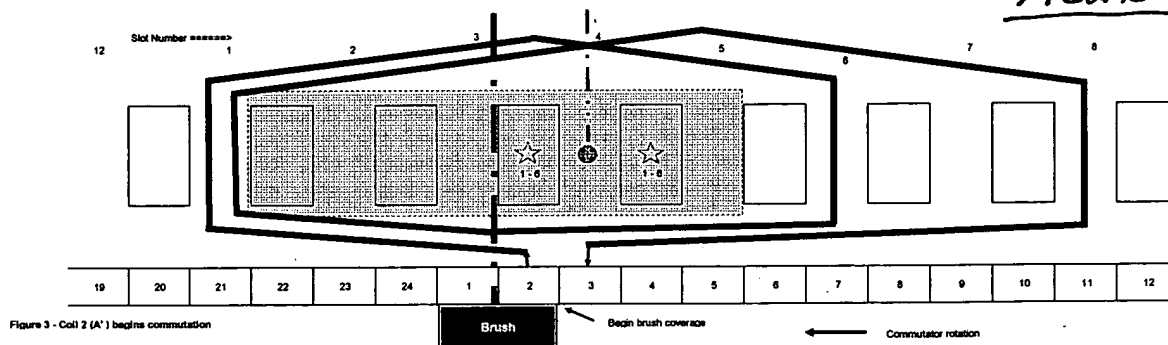


FIGURE 4

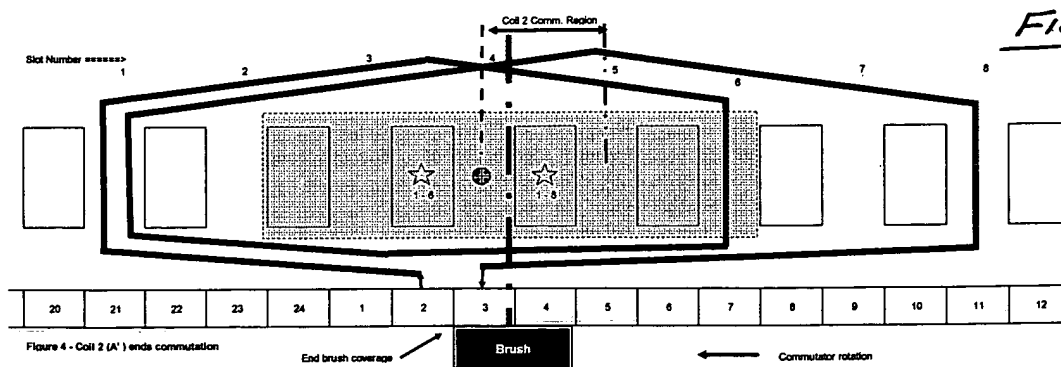


FIGURE 5

Figure 5 - Klein commutation regions are not coincident

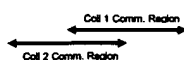


EXHIBIT B